

Observations of Coded Wire Tag Juvenile Chinook Salmon Captured in the Duwamish River and Elliott Bay, Washington.

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Introduction

Spatial and temporal use of the Puget Sound marine nearshore by juvenile hatchery Chinook salmon appears to be more extensive than previously believed. Recent beach seine studies in central Puget Sound have found coded wire tagged (CWT) juvenile Chinook salmon 267 kilometers south and east of release points, with 128 day residence times, covering 25.26 km/day (Brennan et al 2004). This study corroborates south and east migration patterns and prolonged residence times of hatchery Chinook salmon in marine nearshore habitats of Puget Sound.

In 2002 and 2003 Taylor Associates, Inc. and Natural Resource Consultants, Inc. conducted beach seining to determine the spatial and temporal use of the Duwamish River and Elliott by juvenile salmonids. The Port of Seattle (Port) funded this study to improve its understanding of juvenile salmonid spatial and temporal use of habitats adjacent to Port properties. As a result of these efforts, CWT juvenile Chinook salmon were captured and retained to determine hatchery origin and capture location, net direction of travel, time-at-large, minimum distance traveled, and minimum rate of travel.

Methods

Sampling sites included index sites (Turning Basin, Slip 27, Terminal 5, and Pier 90/91) and supplemental sites (Figure 1). Index sites and Shilshole were sampled with a beach seine while Herring's House and Hamm Creek



Figure 1. Location of CWT juvenile Chinook recoveries.

(supplemental sites) were sampled with a block net (habitat restoration monitoring). Index sites were sampled every two weeks from April to October 2002 and February to September 2003. Shilshole and supplemental site CWT recoveries were sampled once in May and June.

While processing the catch of each beach seine set we determined the presence of CWT Chinook with a CWT reader (wand). We collected up to eight CWT juvenile Chinook salmon randomly from each sampling site per sampling event. Retained CWT Chinook were preserved in formalin or frozen for CWT extraction and identification by Washington Department of Fish and Wildlife (WDFW) personnel.

We analyzed the CWT catch data by combining recoveries from both years (2002: n=110, 2003: n=36). Time at large was calculated using the median time range for release dates for fish released volitionally over a period of time. Minimum distance traveled is a straight line distance estimate (via waterways) from the point of release to the point of recapture. Minimum rate of travel is based on the assumption that the fish travel in a straight line from release location to the recapture point. It is also based on the median release dates for volitional releases.

Results

We recovered 146 CWT juvenile Chinook salmon originating from the Soos Creek Hatchery (upstream of the Duwamish River) as well as nine hatcheries of other river systems (Figure 2, Table 1). The list of hatcheries includes

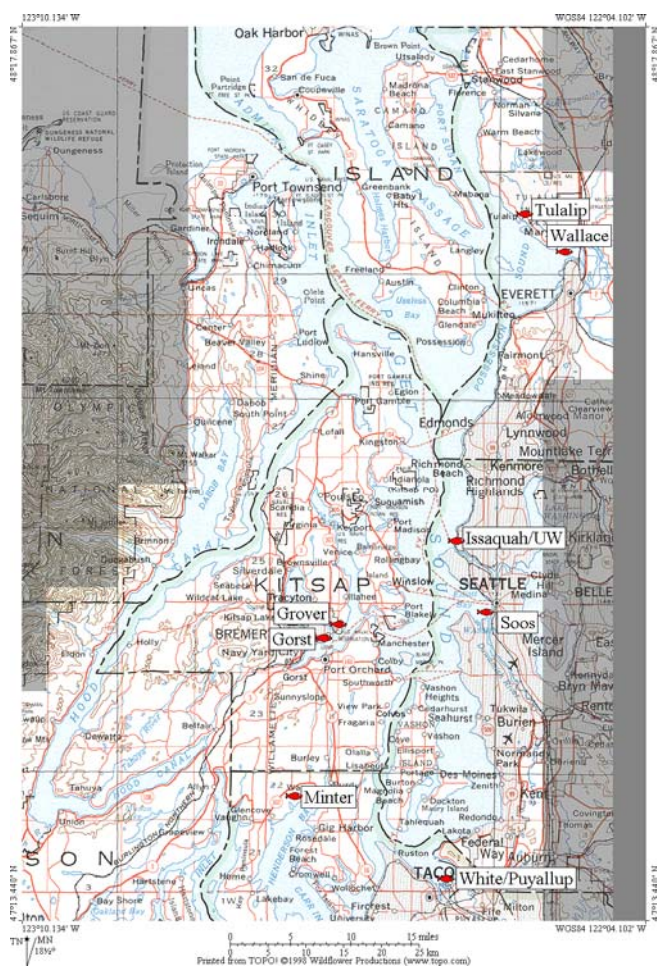


Figure 2. Hatchery origin of CWT juvenile Chinook recoveries (hatchery label located at estuary of parent river).

Table 1. Hatchery origin and recovery location of CWT juvenile Chinook salmon.

Origin	Capture Location							
	Hamm Creek	Herring's House	Pier 90-91	Shilshole	Slip 27	Terminal 5	Turning Basin	West Point
Minter Creek			1					
Tulalip			1					
White River						1		
Gorst Creek						2		
UW, Portage Bay						2		
Issaquah Creek						3		
Puyallup					1	2		
Grovers Creek			1			2		1
Wallace River			15	2		29	1	4
Soos Creek	4	9	10		11	28	16	
Grand Total	4	9	28	2	12	69	17	5

University of Washington (Portage Bay), Gorst Creek, Grovers Creek, White River, Issaquah Creek, Tulalip, Minter Creek, Puyallup River, and Wallace River hatcheries. Soos Creek and Wallace River CWT Chinook salmon dominated the recoveries (35 and 53 percent respectively). Most CWT Chinook were captured at Terminal 5 and Pier 90/91 (47 and 19 percent respectively).

The net direction of travel for some CWT recoveries was not simply in a northerly direction. CWT recoveries moved from north to south (Wallace River, Tulalip, University of Washington, and Issaquah Creek), west to east across open water (Gorst and Grovers), as well as the expected direction of south to north (Minter Creek, White River, and Puyallup River).

The time-at-large for CWT Chinook ranged from 5 to 100 days (Figure 3). CWT recoveries were released from hatcheries between June 4 and June 15, 2002 and May 22 and June 19, 2003.

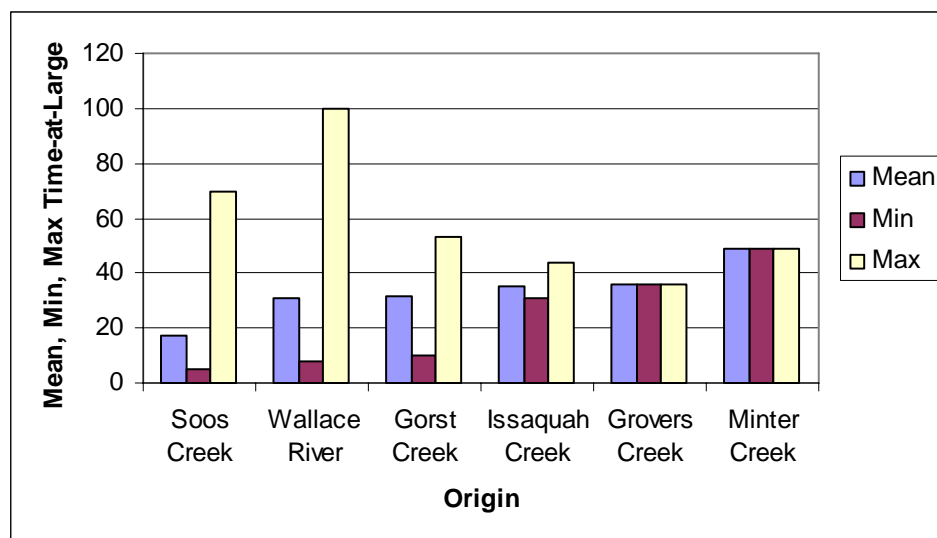


Figure 3. Mean, minimum, and maximum time-at-large (days) for CWT Chinook recoveries (University of Washington, White River, Puyallup River, and Tulalip omitted because release dates are unknown).

We recovered a large enough sample size from the Soos Creek and Wallace River hatcheries to reveal patterns in time-at-large. Wallace River CWT Chinook salmon migrate from their natal stream into the Elliot Bay marine nearshore after most Soos Creek CWT disperse away from Elliott Bay in early summer (Figure 4).

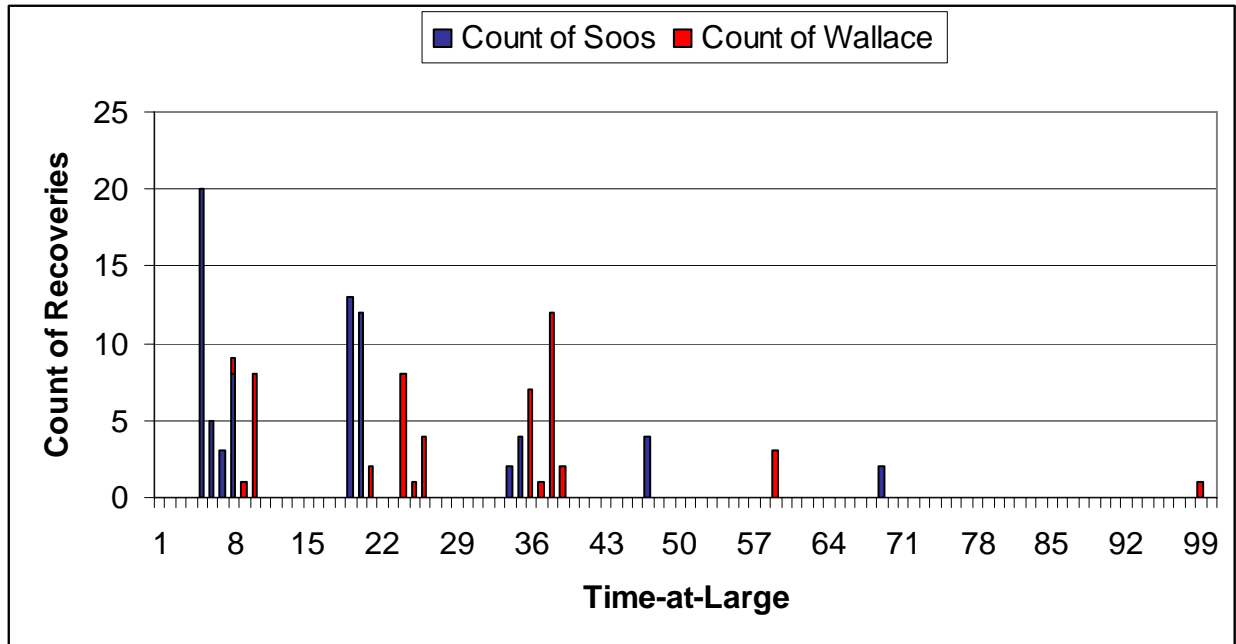


Figure 4. Time-at-Large (days) for Soos Creek and Wallace River CWT recoveries.

Minimum distance traveled was a straight line estimate via water from the release point to recovery point. The minimum distance traveled ranged from 22 to 143 kilometers (Figure 5). The Wallace River CWT recoveries had the greatest minimum distance traveled.

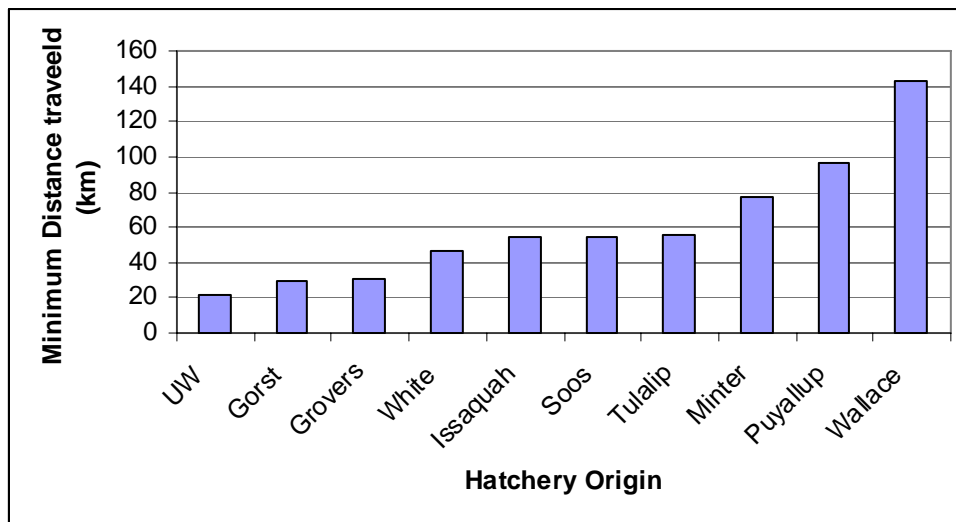


Figure 5. Minimum distance traveled for CWT juvenile Chinook salmon recoveries.

The minimum rate of travel is based on two assumptions: fish travel in a straight line from release point to recovery point and release time is calculated from the median of the volitional hatchery releases. Minimum rates of travel ranged from 0.6 to 17.9 kilometers/day (Figure 6). One Wallace River CWT recovery had the greatest minimum rate of travel.

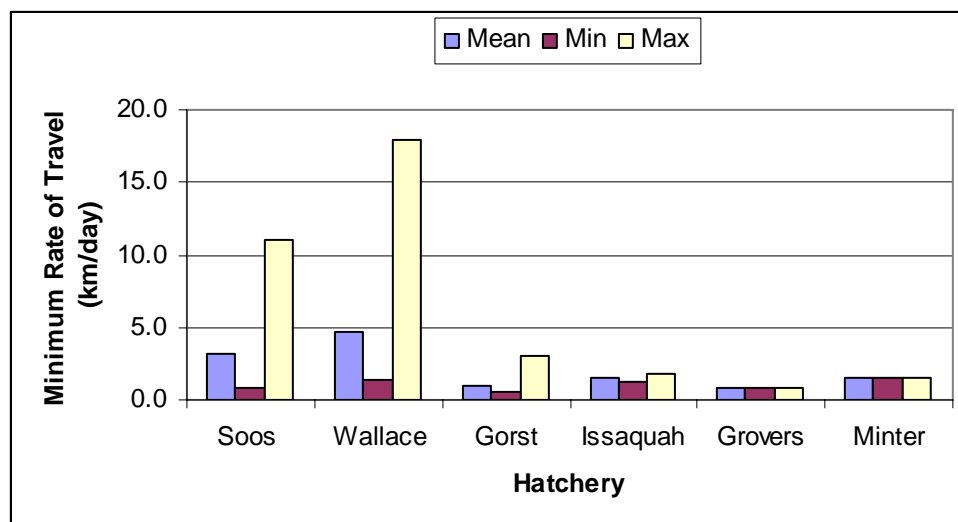


Figure 6. Minimum rate of travel (km/day) for CWT Chinook salmon recoveries.

Conclusions

It is apparent from the CWT recovery data that after migration from their natal rivers, juvenile CWT Chinook salmon disperse broadly within the marine nearshore and are a mixed composition of stocks from around Puget Sound. As anticipated, CWT recoveries from south Puget Sound hatcheries were recovered north of their release point. In a reverse direction and less expected were CWT recoveries from north Puget Sound hatcheries.

In particular, juvenile Chinook from the Wallace River made up 35 percent of the CWT recoveries. These recoveries also occurred later in the year with a majority of fish recovered after 35 days-at-large. Most Soos Creek recoveries were captured within 20 days of release. This can be explained by the proximity of the Soos Creek hatchery to recovery points but does not explain why Soos Creek CWT recoveries were captured less frequently later in the year. Brennan et al (2004) captured Soos Creek CWT's mostly to the south of their natal river system. It appears that a portion of Wallace River and Soos Creek hatchery stocks include a southerly migration route.

Also of note is the apparent migration across open waters of Puget Sound to marine nearshore environments of Elliott Bay (Minter, Gorst, and Grover hatcheries). Time-at-large for these fish (n=4) ranged from 10-53 days with relatively slower minimum rates of travel (0.6-3.0 km/day).

Mean time-at-large for CWT recoveries excluding Soos Creek, was 31 days (n=57). This observation confirms the marine nearshore of Elliott Bay is used by juvenile CWT Chinook salmon into the summer months and beyond. However, we can not say how long an individual CWT recovery spent in freshwater versus marine nearshore habitats prior to capture.

Recent beach seine studies have captured individual juvenile hatchery and wild Chinook in Elliott Bay into October (Taylor Associates, Inc. unpublished data). Terrestrial insects are an important component of juvenile Chinook diets (Brennan et al 2004). This suggests that marine nearshore vegetation plays a role in the feeding ecology of juvenile Chinook salmon in Puget Sound. However, Elliott Bay is highly urbanized with little marine nearshore riparian vegetation and other factors may contribute to the presence of juvenile Chinook salmon.

A number of management actions and future studies can be taken based on the results of this study. Management actions include protecting and restoring marine nearshore habitats of Elliott Bay. Despite its urban environment the Elliott Bay marine nearshore is used by juvenile hatchery Chinook salmon into the summer and fall months. And not just by local stocks of Chinook salmon but by Puget Sound wide populations. The common thread between Chinook salmon stocks of Puget Sound is the marine environment.

References

Brennan, J.S., K.F. Higgins, J.R. Cordell, and V.A. Stamatiou. 2004. Juvenile Salmon Composition, Timing, Distribution, and Diet in the Marine Nearshore Waters of Central Puget Sound in 2001-2002. King County Department of Natural Resources and Parks, Seattle, WA. 164 pp.

Taylor Associates, Inc. Unpublished data. Beach seine data collected in 1998, 2000, 2002, and 2003 in the Duwamish River and Elliot Bay. Studies conducted for the Port of Seattle.